ENVIRONMENTAL SENSITIVITY INDEX: MISSISSIPPI

INTRODUCTION

Environmental Sensitivity Index (ESI) maps have been developed for the shoreline of Mississippi to encompass the coastal areas including the Gulf Islands National Seashore. The ESI maps include information for three main components: shoreline habitats; sensitive biological resources; and human-use resources. The methods of data collection and presentation are summarized in the following sections.

SHORELINE HABITAT MAPPING

The shoreline habitats of Mississippi were characterized as to their sensitivity to oil spills using a shoreline classification system which has been used by the National Oceanic and Atmospheric Administration (NOAA) for all ESI maps nationwide. Prediction of the behavior and persistence of oil on intertidal habitats is based on an understanding of the dynamics of the coastal environments, not just the substrate type and grain size. The vulnerability of a particular habitat is an integration of the following factors:

1) Shoreline type (substrate, grain size, tidal elevation, origin)
2) Exposure to wave and tidal energy
3) Biological productivity and sensitivity
4) Ease of cleanup

All of these factors are used to determine the relative sensitivity of intertidal habitats. Key to the sensitivity ranking is an understanding of the relationships between: physical processes, substrate, shoreline type, product type, fate and effect, and sediment transport patterns. The intensity of energy expended upon a shoreline by wave action, tidal currents, and river currents directly affects the persistence of stranded oil. The need for shoreline cleanup activities is determined, in part, by the slowness of natural processes in removal of oil stranded on the shoreline.

These concepts have been used in the development of the ESI, which ranks shoreline environments as to their relative sensitivity to oil spills, potential biological injury, and ease of cleanup. Generally speaking, areas exposed to high levels of physical energy, such as wave action and tidal currents, and low biological activity rank low on the scale, whereas sheltered areas with associated high biological activity have the highest ranking. The list below includes the shoreline habitats delineated for Mississippi, presented in order of increasing sensitivity to spilled oil.

1) Exposed Walls and Other Solid Structures Made of Concrete, Wood, or Metal
2A) Scarps and Steep Slopes in Clay (Not Present in Study Area)
2B) Wave-cut Clay Platforms (Not Present in Study Area)
3A) Fine-grained Sand Beaches
3B) Scarps and Steep Slopes in Sand
4) Coarse-grained Sand Beaches (Not Present in Study Area)
5) Mixed Sand and Gravel (Shell) Beaches
6A) Gravel (Shell) Beaches
6B) Exposed Riprap Structures
7) Exposed Tidal Flats
8A) Sheltered Solid Man-made Structures
8B) Sheltered Riprap Structures
8C) Sheltered Scarps
9A) Sheltered Tidal Flats (Not Present in Study Area)
9B) Riverine Banks with Grasses or Trees
10A) Salt and Brackish Water Marshes
10B) Freshwater Marshes (Herbaceous Vegetation)
10C) Freshwater Swamps (Woody Vegetation)

Mapping of the shoreline habitats of Mississippi was accomplished using a variety of techniques because the U.S. Geological Survey (USGS) topographic quadrangles are very out-of-date for much of the Gulf of Mexico shoreline. Three different sources for the shoreline were used. The USGS Digital Line Graph (DLG) files were used as a base layer for the shorelines, especially along rivers, creeks, and interior water bodies. For shorelines along bays and the Mississippi Sound, an accurate shoreline was interpreted from the 1:24,000 scale vertical color infrared photography flown by the U.S. Army Corps of Engineers in 1986. These updated interpretations were merged with the DLG base. For the barrier islands shoreline and most of the mainland shoreline along Mississippi Sound, each year staff from the Mississippi Office of Geology walk the normal high tide mark and use Global Positioning System (GPS) receivers to map the shoreline position within three-meter accuracy. The 1994 GPS-measured shorelines were merged into the 1986 shoreline to produce the most accurate shoreline for the study area.

The shoreline was then classified with the above ESI ranking system using oblique aerial videography taken in July 1993. The shoreline habitat was marked onto 1:24,000 scale paper maps: for the barrier islands, the maps were generated from the 1994 GPS-generated shoreline; for the mainland areas, USGS topographic maps were used; for interior rivers and bays, the shoreline habitats were mapped onto USGS quadrangles during field surveys using small boats and updated in the digital shoreline. Where appropriate, multiple habitats were delineated for each shoreline segment. The maps were then field checked during overflights on 12 and 13 October 1995 by coastal geologists from Research Planning, Inc. (RPI) and the Mississippi Office of Geology.

Each of the shoreline habitats is described on pages 6 through 12, in terms of their physical description, predicted oil behavior, and response considerations. Summary statistics are given for each shoreline habitat, in terms of the percent of the total shoreline length as mapped along the Mississippi coast. These statistics were calculated by summing the shoreline lengths for each habitat type, double counting the segments where more than one shoreline type was mapped. Therefore, even though the length of actual shoreline mapped, which includes bays and the lower parts of rivers, was determined to be 3,041 kilometers, the sum of all classified shorelines was 3,100 kilometers.

SENSITIVE BIOLOGICAL RESOURCES

Biological information was compiled from various state and federal sources including the Mississippi Bureau of Marine Resources, U.S. National Biological Service, and the U.S. National Park Service. Information collected and depicted on the maps denotes the key biological resources that are most likely at risk in the event of an oil spill. Six major categories of biological resources were considered during production of the maps: terrestrial mammals, birds, reptiles, fish, shellfish, and habitats.

Spatial distribution of the species on the maps is represented by polygons, lines, and points, as appropriate. Associated with each of these representations is an icon depicting the types of habitats or animals that are present. Species have been divided into groups and subgroups, based on their behavior and taxonomic classification. The icons reflect this grouping scheme. The groups are color coded, and the subgroups are represented by different icons as follows:

TERRESTRIAL MAMMALS

Small Mammals

BIRDS

Diving Birds

Gulls and Terns

Pelagic Birds

Raptors

Shorebirds

Wading Birds

Waterfowl

REPTILES

Alligators

Snakes

Turtles

FISH

Fish

SHELLFISH

Bivalves

Crabs

Shrimp

HABITATS

Submerged Aquatic Vegetation

The polygon, line, or point color and pattern are the same for all the animals in one group. When there is more than one group of animals in one polygon, the polygon is then assigned the multi-group color and pattern (black hatch polygon). Also associated with each polygon on the map is a number (located under the icon for the polygon). This number references a table on the reverse side of the map with a complete list of species found in the polygon as well as life-history information on each species present.

There are some species that are found throughout the nearshore zone on the map. While it is important to note the presence of these species, showing these distributions as polygons would cover large areas, making the maps very difficult to read. Thus, species which have an area greater than 25 percent of the water area are identified in a box stating that they are “COMMON IN AREA”. This approach informs the user of the presence of these species, while maintaining readability of the map.

TERRESTRIAL MAMMALS

Both marine and terrestrial mammals were considered for inclusion on the ESI maps. The predominate species of marine mammal in the Mississippi coastal area is bottlenose dolphin. They are present throughout state waters with no particular areas of concentration. In order to keep the maps more readable, dolphin was not included. It is important to realize that dolphins are present everywhere along the coast and are an important resource to consider during planning and spill response.

Terrestrial mammals shown on the maps are northern raccoon, mink, nutria, muskrat, beaver, river otter, and wild hogs. The hogs are shown because they are very aggressive and their presence may be a threat to people during spill response activities. Terrestrial mammal concentration areas are shown by a brown hatch polygon. However, if species in addition to terrestrial mammals are included in the polygon, a black hatch (multigroup) polygon is used. A brown icon associated with the polygon has a silhouette indicating terrestrial mammals. The number under the icon references a table on the reverse side of the map. In this table, the first column gives the species name. The second column denotes whether the species has been designated as endangered (E) and/or threatened (T) status on the state (S) and/or federal (F) lists. No terrestrial mammals on the maps have such designations. The next column provides an estimate of the concentration of species at this site. No concentration is designated on the maps. The species seasonality is shown in the next twelve columns, representing the months of the year. If the species is present at that location in a particular month, an 'X' is placed in the month column.

BIRDS

Birds are divided into several species subgroups based on behavior and taxonomy. The species table lists all the birds included on the maps, sorted by subgroup. These species were included either because of their likelihood of impact by an oil spill or special protection status as threatened or endangered. Bird distribution is shown on the maps as points and polygons. Green dots on the maps depict known nesting sites. Bird concentrations are shown as a green hatch polygon; however, if species in addition to birds are in the polygon, a black hatch (multigroup) polygon is used. Green icons with a silhouette identifying which bird subgroup is present are associated with each point or polygon. If one or more species in a subgroup are threatened or endangered, a red box appears around the icon. The number under the icon references a table on the reverse side of the map. In this table, the first column gives the species name, followed by the state (S) and/or federal (F) species designation for endangered (E) or threatened (T) status. The next column provides an estimate of the concentration of species at this site. Concentration is available for nesting sites and is indicated as "HIGH". The species seasonality is shown in the next twelve columns, representing the months of the year. If the species is present at that location in a particular month, an 'X' is placed in the month column. The last four columns denote the times for nesting, laying, hatching, and fledging at this site.

REPTILES

Reptiles shown on the maps include sea turtles, alligators, Gulf salt marsh snakes, and Mississippi diamondback terrapins. All of these species are on a state or federal list as either threatened or endangered. Although the loggerhead, leatherback, and Kemp's ridley sea turtles are present throughout the coastal waters of Mississippi, site-specific information is only available for the loggerhead sea turtle. There are no known water concentration areas. The Atlantic loggerhead sea turtle is the only sea turtle species shown on the maps, and only nesting beaches are shown. The alligator may be a threat to cleanup operations, especially on the Gulf Islands.

The reptile concentration areas and nesting beaches are shown as polygons with a red hatch pattern. If species in addition to turtles are present in the polygons, a black hatch (multigroup) pattern is used. Red icons are associated with the polygons, and a silhouette of a turtle is shown. In addition, a red box appears around the icon indicating the species is threatened. The number under the icon references a table on the reverse side of the map. In this table, the first column gives the species name. The second column denotes whether the species has been designated endangered (E) or threatened (T) on either the state (S) or federal (F) list. The next column provides an estimate of the concentration of species at this site. Concentration, where available, is indicated as "HIGH", "MED", or "LOW". These estimates are subjective based on local expert opinion on the relative concentrations in the area. The species seasonality is shown in the next twelve columns, representing the months of the year. If the species is present at that location in a particular month, an 'X' is placed in the month column. The next-to-last column indicates the most likely dates for egg laying by loggerhead sea turtles. The last column indicates when the young hatch and escape to the Gulf.

FISH

Fish distributions shown on the map represent spawning areas, areas of particularly high concentrations of selected species, and anadromous streams. Distribution and concentrations of the fish are based primarily on trawl surveys conducted throughout Mississippi Sound and adjoining bays and rivers. The species table lists all the fish included on the maps. Fish species were compiled into assemblages for specific water bodies (e.g., Gulf of Mexico, Mississippi Sound, Mississippi bays, and freshwater rivers), as listed on page 5. These assemblages include many similar species, thus only one icon is used for all fish, instead of one icon for each subgroup, as with the other groups. Concentration or spawning areas for fish are shown as polygons on the maps. Fish polygons are shown as a blue hatch pattern; however, if species in addition to fish are in the polygon, a black hatch (multigroup) pattern is used. Blue icons are associated with the polygons. If the polygon includes Gulf sturgeon, the only threatened fish species, a red box appears around the icon. The number under the icon references a table on the reverse side of the map. In this table, the first column gives the species name. The second column denotes whether the species has been designated endangered (E) or threatened (T) on either the state (S) or federal (F) list. The next column provides an estimate of the concentration of species at this site. No concentration is designated on the maps. The species seasonality is shown in the next twelve columns, representing the months of the year. If the species is present at that location in a particular month, an 'X' is placed in the month column. The last two columns denote normal times for spawning (all fish) and outmigration (anadromous fish).

SHELLFISH

Shellfish have been divided into three subgroups: shrimp, crabs, and bivalves (clam, oyster, scallop). The species table lists all the shellfish shown on the maps, sorted by subgroup. Species that are commercially or recreationally important are included. The distribution of shellfish is shown as polygons with an orange hatch pattern. If species in addition to shellfish are included in the polygon, a black hatch (multigroup) pattern is used. Orange icons are associated with the polygons, and the silhouette of the subgroup is shown. The number under the icon references a table on the reverse side of the map. In this table, the first column gives the species name. The second column denotes whether the species has been designated endangered (E) or threatened (T) on either the state (S) or federal (F) list. No shellfish on the maps have such designations. The next column provides an estimate of the concentration of species at this site. Concentration is indicated as "HIGH" for areas in Biloxi Bay. These estimates are subjective based on local expert opinion on the relative concentrations in the area. The species seasonality is shown in the next twelve columns, representing the months of the year. If the species is present at that location in a particular month, an 'X' is placed in the month column. The last columns indicates dates for spawning and juvenile concentrations.

HABITATS

The only habitats shown on the maps are submerged aquatic vegetation (SAV). The SAV beds were mapped from aerial photographs taken by the National Biological Service in 1992. The SAV beds are shown as polygons with a purple hatch pattern. If species in addition to plants are present in the polygons, a black hatch (multigroup) pattern is used. Purple icons are associated with the polygons, and the seagrass silhouette is shown. The number under the icon references a table on the reverse side of the map. In this table, the first column gives the species name. The second column denotes whether the species has been designated endangered (E) or threatened (T) on either the state (S) or federal (F) list. No seagrasses have such designation. The next column provides an estimate of the concentration of species at this site. Concentration is indicated using NBS's scheme of "CONTINUOUS", "DENSE", "MODERATE", "SPARSE", or "VERY SPARSE". The last twelve columns provide information on seasonality. All 12 months are marked with an 'X' since the plants are present all year.

HUMAN-USE FEATURES

The human-use features depicted on the maps are those that either could be impacted by an oil spill or could provide access for the cleanup operation. All the features are represented by icons indicating the type of feature. If the icon is not placed on the location of the feature, a leader line is drawn from the icon to the proper location.

General locations for some archaeological sites are indicated on the map. Only the sites that might be impacted directly by a marine spill, or the associated cleanup activities, are shown. Sites were determined to be potentially impacted if they were located in wetlands, on the shoreline, or between an access road and the shoreline. The icons on the map are an approximate location (within 0.5 miles) of the site. In the Gulf Islands National Seashore there are numerous sites throughout the islands and only one icon is used on each map to indicate that sites are present. If there is an incident that will impact in the vicinity of an archaeological site, the Mississippi Department of Archives and History must be contacted at (601) 359-6940. This office can advise on how to proceed with regard to the archaeological site.

Aquaculture in coastal Mississippi consists of oyster lease beds distributed throughout Mississippi Sound. These sites are shown on the maps as oyster reefs and not aquaculture facilities. Depicting the lease beds as reefs shows the extent of the leased areas and better quantifies the resource than an aquaculture symbol would.

Airport—Location of airfields or airports whether they are manned or unmanned. The locations were obtained from visual observations during the overflights or from U.S. Geological Survey (USGS) topographic maps.

Archaeological site—Location of known archaeological sites in close proximity to the shoreline. This information was provided by the Mississippi Department of Archives and History.

Boat ramp—Location of boat ramps. This information was obtained from the Mississippi Bureau of Marine Resources and overflight observations.

Ferry—Location of ferry docks.

Marina—Location of any marinas. This information was from the Mississippi Bureau of Marine Resources and overflight observations.

National park—An icon is used to show the location of the national park, but the digitized boundary was obtained from the NOAA nautical chart.

State park—An icon is used to show the location of the state park.

Recreational fishing/boating—General area of heavy fishing usually associated with artifical reefs.

Recreational beach—Location of a recreational beach. These sites are indicated with an icon; the beach boundaries were not digitized. Information was provided by the Mississippi Bureau of Marine Resources.

Reserve, preserve, or refuge—All boundaries for the reserves, preserves, refuges, or any other managed and regulated wildlife area were provided by USFWS. The boundary is shown on the map with an icon and the name along the boundary.

GEOGRAPHIC INFORMATION SYSTEM DATA

The entire atlas product is stored in digital form in a Geographic Information System (GIS). The information is stored as geographic layers and associated databases. The format for the data varies depending on the type of information or features for which the data are being stored. The three major formats are shoreline habitat classification, biological resources, and human-use features.

Under separate cover is a metadata document which details the data dictionary, processing techniques, and descriptive information for the digital data sets and maps that were used to create this atlas. Below is a brief synopsis of the information contained in the digital version. Refer to the metadata file for a full explanation of the data and its structure.

SHORELINE HABITAT CLASSIFICATION

The shoreline habitat classification is stored as lines with the data identifying the type of habitat associated with the line. In many cases, a shoreline may have two or three different classifications. These multiple classifications are represented on the maps by double and triple lines, and in the database by ESI#1/ESI#2 where ESI#1 is the landward-most classification and ESI#2 is the seaward-most classification.

SENSITIVE BIOLOGICAL RESOURCES

Biological resources are stored as lines, points, or polygons. Associated with each feature is a unique identification number which is linked to a series of databases that further identify the resources. The first data set consists of a list of the species and the concentration of each species. This dataset is then linked to a dataset that describes the life history of each species (temporal presence and reproductive/lifehistory time periods at month resolution) for the specified map feature. Other databases linked to the first data set are the species identification database, which includes common and scientific names for all species and their threatened or endangered status, and the sources database, which provides source metadata at the feature level.

HUMAN-USE FEATURES

Human-use features are represented as points and lines, and polygons for managed lands. All metadata sources are documented at the feature level.

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At Research Planning, Inc. (RPI), Jacqueline Michel and Jeffrey Dahlin were the project scientists. Todd M. Montello participated in the field verification of the shoreline classification. James Olsen entered the data and produced the final maps under the supervision of Joanne Halls. Graphics were provided by Joe Holmes, and Dot Zaino prepared the text.

SPECIES LIST*

Common Name	Species Name
TERRESTRIAL MAMMALS	
SMALL MAMMALS	
Beaver	*Castor canadensis*
Mink	*Mustela vison*
Muskrat	*Ondatra zibethicus*
Northern raccoon	*Procyon lotor*
Nutria	*Myocastor coypus*
River otter	*Lutra canadensis*
Wild hog	*Pigus stinkus*
BIRDS	
DIVING BIRDS	
American white pelican	*Pelecanus erythrorhynchos*
Brown pelican	*Pelecanus occidentalis*
Common loon	*Gavia immer*
Double-crested cormorant	*Phalacrocorax auritus*
Horned grebe	*Podiceps auritus*
Pied-billed grebe	*Podilymbus podiceps*
GULLS AND TERNS	
Black skimmer	*Rynchops niger*
Black tern	*Chlidonias niger*
Bonaparte's gull	*Larus philadelphia*
Caspian tern	*Sterna caspia*
Herring gull	*Larus argentatus*
Laughing gull	*Larus atricilla*
Least tern	*Sterna antillarum*
Ring-billed gull	*Larus delawarensis*
Royal tern	*Sterna maxima*
Sandwich tern	*Sterna sandvicensis*
Sooty tern	*Sterna fuscata*
PELAGIC	
Northern gannet	*Morus bassanus*
RAPTORS	
Bald eagle	*Haliaeetus leucocephalus*
Northern harrier	*Circus cyaneus*
Osprey	*Pandion haliaetus*
Peregrine falcon	*Falco peregrinus*
SHOREBIRDS	
American oystercatcher	*Haematopus palliatus*
Black-bellied plover	*Pluvialis squatarola*
Killdeer	*Charadrius vociferus*
Piping plover	*Charadrius melodus*
Sanderling	*Calidris alba*
Semipalmated plover	*Charadrius semipalmatus*
Snowy plover	*Charadrius alexandrinus*
Willet	*Catoptrophorus semipalmatus*
Wilson's plover	*Charadrius wilsonia*
WADING BIRDS	
American bittern	*Botaurus lentiginosus*
Black rail	*Laterallus jamaicensis*
Black-crowned night heron	*Nycticorax nycticorax*
Cattle egret	*Bubulcus ibis*
Clapper rail	*Rallus longirostris*
Great blue heron	*Ardea herodias*
Great egret	*Casmerodius albus*
Green-backed heron	*Butorides striatus*
King rail	*Rallus elegans*
Least bittern	*Ixobrychus exilis*
Little blue heron	*Egretta caerulea*
Mississippi sandhill crane	*Grus canadensis pulla*
Reddish egret	*Egretta rufescens*
Snowy egret	*Egretta thula*
Tricolored heron	*Egretta tricolor*
White ibis	*Eudocimus albus*
Yellow-crowned night heron	*Nyctanassa violacea*
Yellow rail	*Coturnicops noveboracensis*
WATERFOWL	
American coot	*Fulica americana*
American wigeon	*Anas americana*
Blue-winged teal	*Anas discors*
Bufflehead	*Bucephala albeola*
Canvasback	*Aythya valisineria*
Common goldeneye	*Bucephala clangula*
Common moorhen	*Gallinula chloropus*
Gadwall	*Anas strepera*
Greater scaup	*Aythya marila*
Green-winged teal	*Anas crecca*
Hooded merganser	*Lophodytes cucullatus*
Lesser scaup	*Aythya affinis*
Mallard	*Anas platyrhynchos*
Mottled duck	*Anas fulrigula*
Northern pintail	*Anas acuta*

SPECIES LIST*

Common Name	Species Name
BIRDS (continued)	
WATERFOWL (continued)	
Northern shoveler	*Anas clypeata*
Oldsquaw	*Clangula hyemalis*
Purple gallinule	*Porphyrula martinica*
Red-breasted merganser	*Mergus serrator*
Redhead	*Aythya americana*
Ring-necked duck	*Aythya collaris*
Snow goose	*Chen caerulescens*
REPTILES	
TURTLES	
American alligator	*Alligator mississippiensis*
Gulf salt marsh snake	*Nerodia clarkii*
Loggerhead sea turtle	*Caretta caretta*
Mississippi diamondback terrapin	*Malaclemys terrapin pileata*
FISH	
ANADROMOUS	
Atlantic sturgeon	*Acipenser oxyrhynchus*
Gulf sturgeon	*Acipenser oxyrhynchus desotoi*
Skipjack herring	*Alosa chrysochloris*
Striped bass	*Morone saxatilis*
SPECIAL CONCENTRATIONS	
Atlantic croaker	*Micropogonias undulatus*
Atlantic sharpnose shark	*Rhizoprionodon terraenovae*
Atlantic spadefish	*Chaetodipterus faber*
Atlantic thread herring	*Opisthonema oglinum*
Bay anchovy	*Anchoa mitchilli*
Black drum	*Pogonias cromis*
Blacktip shark	*Carcharhinus limbatus*
Blue catfish	*Ictalurus furcatus*
Blue runner	*Caranx crysos*
Bluefish	*Pomatomus saltatrix*
Bluegill	*Lepomis macrochirus*
Bull shark	*Carcharhinus leucas*
Channel catfish	*Ictalurus punctatus*
Cobia	*Rachycentron canadum*
Crevalle jack	*Caranx hippos*
Florida pompano	*Trachinotus carolinus*
Gafftopsail catfish	*Bagre marinus*
Gag grouper	*Mycteroperca microlepis*
Gizzard shad	*Dorosoma cepedianum*
Gray snapper	*Lutjanus griseus*
Gulf butterfish	*Peprilus burti*
Gulf flounder	*Paralichthys albigutta*
Gulf killifish	*Fundulus grandis*
Gulf kingfish	*Menticirrhus littoralis*
Gulf menhaden	*Brevoortia patronus*
Halfbeak	*Hyporhamphus unifasciatus*
Hardhead catfish	*Arius felis*
Harvestfish	*Peprilus alepidotus*
Inland silverside	*Menidia beryllina*
King mackerel	*Scomberomorus cavalla*
Ladyfish	*Elops saurus*
Lane snapper	*Lutjanus synagris*
Largemouth bass	*Micropterus salmoides*
Little tunny	*Euthynnus alletteratus*
Longear sunfish	*Lepomis megalotis*
Longnose killifish	*Fundulus similis*
Marsh killifish	*Fundulus confluentus*
Northern kingfish	*Menticirrhus saxatilis*
Pigfish	*Orthopristis chrysoptera*
Pinfish	*Lagodon rhomboides*
Rainwater killifish	*Lucania parva*
Red drum	*Sciaenops ocellatus*
Red snapper	*Lutjanus campechanus*
Redear sunfish	*Lepomis microlophus*
Rock sea bass	*Centropristis philadelphica*
Rough scad	*Trachurus lathami*
Rough silverside	*Membras martinica*
Sailfin molly	*Poecilia latipinnaa*
Sand seatrout	*Cynoscion arenarius*
Scaled sardine	*Harengula jaguana*
Sea catfish	*Galeichthyes felis*
Seatrout	*Cynoscion sp.*
Sheepshead	*Archosargus probatocephalus*
Sheepshead minnow	*Cyprinodon variegatus*
Shiners	*Notropis spp.*
Silver perch	*Bairdiella chrysoura*
Silver seatrout	*Cynoscion nothus*
Southern flounder	*Paralichthys lethostigma*
Southern hake	*Urophycis floridanus*

* Threatened and endangered species are designated by underlining.

SPECIES LIST*

Common Name	Species Name
FISH (continued)	
SPECIAL CONCENTRATIONS (continued)	
Southern kingfish (whiting)	*Menticirrhus americanus*
Spanish mackerel	*Scomberomorus maculatus*
Spinner shark	*Carcharhinus brevipinna*
Spot	*Leiostomus xanthurus*
Spotfin mojarra	*Eucinostomus argenteus*
Spotted hake	*Urophycis regius*
Spotted seatrout	*Cynoscion nebulosus*
Spotted sunfish	*Lepomis punctatus miniatus*
Star drum	*Stellifer lanceolatus*
Striped anchovy	*Anchoa hepsetus*
Striped mullet	*Mugil cephalus*
Tarpon	*Megalops atlanticus*
Threadfin shad	*Dorosoma petenense*
White mullet	*Mugil curema*
Whitespotted greenling	*Hexagrammos stelleri*
SHELLFISH	
BIVALVES	
American oyster (eastern)	*Crassostrea virginica*
Atlantic bay scallop	*Argopecten irradians*
Brackishwater clam	*Rangia cuneata*
Southern quahog (hard clam)	*Mercenaria campechiensis*
CRABS	
Blue crab	*Callinectes sapidus*
Stone crab	*Menippe mercenaria*
SHRIMP	
Brown shrimp	*Penaeus aztecus*
Pink shrimp	*Penaeus duorarum*
White shrimp	*Penaeus setiferus*
HABITATS	
SUBMERGED AQUATIC VEGETATION	
Seagrass	

* Threatened and endangered species are designated by underlining.

FISH SPECIES ASSEMBLAGES

GULF OF MEXICO

NAME	J	F	M	A	M	J	J	A	S	O	N	D	SPAWNING	OUTMIG	LARVAE
Atlantic croaker	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-
Atlantic spadefish				X	X	X	X	X	X	X	X		-	-	-
Atlantic thread herring					X	X	X	X	X	X			-	-	-
Bay anchovy	X	X	X	X	X	X	X	X	X	X	X	X	FEB-OCT	-	-
Blue runner	X	X	X	X	X	X	X	X	X	X	X	X	-	-	MAR-SEP
Bluefish	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-
Cobia				X	X	X	X	X	X				-	-	-
Crevalle jack						X	X						-	-	-
Florida pompano					X	X	X	X	X	X	X		-	-	-
Gafftopsail catfish				X	X	X	X	X	X				JUN-JUL	-	-
Gag grouper							X	X	X				-	-	-
Gray snapper					X	X	X	X	X	X	X	X	-	-	-
Gulf butterfish	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-
Gulf flounder	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-
Gulf kingfish							X	X	X				-	-	-
Gulf menhaden	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-
Gulf menhaden	X	X							X	X	X	OCT	-FEB	-	-
Harvestfish					X	X	X	X	X	X			-	-	-
King mackerel				X	X	X	X	X	X	X			-	-	-
Lane snapper					X	X	X	X	X	X	X	X	-	-	-
Little tunny	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-
Northern kingfish					X	X	X	X	X	X	X	X	-	-	-
Pigfish				X	X	X	X	X	X	X	X		-	-	-
Pinfish	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-
Red drum	X	X	X	X	X	X	X	X	X	X	X	X	SEP-OCT	-	-
Red snapper					X	X	X	X	X	X	X	X	-	-	-
Rough scad						X	X	X	X	X			-	-	-
Sand seatrout	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-
Scaled sardine					X	X	X	X	X	X	X		-	-	-
Seatrout	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-
Sheepshead	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-
Silver perch	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-
Silver seatrout					X	X	X	X	X	X	X		-	-	JUN-OCT
Southern flounder	X	X	X	X	X	X	X	X	X	X	X	X	MAR-MAY	-	-
Southern hake			X	X	X	X							-	-	-
Southern kingfish (whiting)			X	X	X	X	X	X	X	X	X	X	-	-	-
Spanish mackerel						X	X	X	X				-	-	-
Spot	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-
Spotfin mojarra	X						X	X	X	X	X		-	-	-
Spotted hake			X	X									-	-	-
Spotted seatrout	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-
Star drum									X				-	-	-
Striped anchovy					X	X	X	X	X	X	X		MAY-AUG	-	-
Striped bass				X	X	X							APR-JUN	-	-
Striped mullet	X	X	X	X	X	X	X	X	X	X	X	X	NOV-MAY	-	-
Tarpon	X	X	X	X	X	X	X	X	X	X	X	X	-	-	MAR-SEP
Threadfin shad	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-
White mullet	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-

MISSISSIPPI SOUND

NAME	J	F	M	A	M	J	J	A	S	O	N	D	SPAWNING	OUTMIG	LARVAE
Atlantic croaker	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-
Atlantic sharpnose shark			X	X	X	X	X	X					-	-	-
Atlantic spadefish			X	X	X	X	X	X	X	X			-	-	-
Bay anchovy	X	X	X	X	X	X	X	X	X	X	X	X	FEB-OCT	-	-
Black drum	X	X	X	X	X	X	X	X	X	X	X	X	-	-	FEB-APR
Blacktip shark	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-
Bull shark	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-
Crevalle jack						X	X						-	-	-
Florida pompano					X	X	X	X	X	X	X		-	-	-
Gafftopsail catfish				X	X	X	X	X	X	X			JUN-JUL	-	-
Gag grouper								X	X	X			-	-	-
Gray snapper						X	X	X	X	X	X	X	-	-	-
Gulf butterfish	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-
Gulf flounder	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-
Gulf kingfish							X	X	X				-	-	-
Gulf menhaden	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-
Gulf menhaden	X	X							X	X	X	OCT	-FEB	-	-
Harvestfish					X	X	X	X	X	X			-	-	-
King mackerel				X	X	X	X	X	X	X			-	-	-
Lane snapper					X	X	X	X	X	X	X	X	-	-	-
Little tunny	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-
Northern kingfish					X	X	X	X	X	X	X	X	-	-	-
Pigfish				X	X	X	X	X	X	X	X		-	-	-
Pinfish	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-
Red drum	X	X	X	X	X	X	X	X	X	X	X	X	SEP-OCT	-	-
Red snapper					X	X	X	X	X	X	X	X	-	-	-
Rough scad						X	X	X	X	X			-	-	-
Sand seatrout	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-
Scaled sardine					X	X	X	X	X	X	X		-	-	-
Seatrout	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-
Sheepshead	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-
Silver perch	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-
Silver seatrout					X	X	X	X	X	X	X		-	-	JUN-OCT
Southern flounder	X	X	X	X	X	X	X	X	X	X	X	X	MAR-MAY	-	-
Southern hake			X	X	X	X							-	-	-
Southern kingfish (whiting)			X	X	X	X	X	X	X	X	X	X	-	-	-
Spanish mackerel						X	X	X	X				-	-	-
Spot	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-
Spotfin mojarra	X						X	X	X	X	X		-	-	-
Spotted hake			X	X									-	-	-
Spotted seatrout	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-
Star drum									X				-	-	-
Striped anchovy					X	X	X	X	X	X	X		MAY-AUG	-	-
Striped bass				X	X	X							APR-JUN	-	-
Striped mullet	X	X	X	X	X	X	X	X	X	X	X	X	NOV-MAY	-	-
White mullet	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-

MISSISSIPPI BAYS

NAME	J	F	M	A	M	J	J	A	S	O	N	D	SPAWNING	OUTMIG	LARVAE
Atlantic croaker	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-
Bay anchovy	X	X	X	X	X	X	X	X	X	X	X	X	FEB-OCT	-	-
Blue catfish	X	X	X	X	X			X	X	X	X	X	-	-	-
Channel catfish	X	X	X	X			X	X					MAR-MAR	-	-
Florida pompano					X	X	X	X	X	X	X		-	-	-
Gafftopsail catfish				X	X	X	X	X	X	X			JUN-JUL	-	-
Gulf butterfish	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-
Gulf killifish	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-
Gulf menhaden	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-
Gulf menhaden	X	X								X	X	X	OCT-FEB	-	-
Hardhead catfish				X	X	X	X	X	X	X	X		MAY-AUG	-	-
Harvestfish					X	X	X	X	X	X			-	-	-
Ladyfish				X	X	X	X	X	X				-	-	-
Longnose killifish	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-
Pigfish			X	X	X	X	X	X	X	X			-	-	-
Pinfish	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-
Red drum	X	X	X	X	X	X	X	X	X	X	X	X	SEP-OCT	-	-
Sailfin molly	X	X					X	X	X	X	X		-	-	-
Sand seatrout	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-
Scaled sardine				X	X	X	X	X	X	X			-	-	-
Sheepshead	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-
Sheepshead minnow	X	X	X	X	X	X	X	X	X	X	X	X	-	-	APR-OCT
Silver perch	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-
Skipjack herring	X		X	X	X	X				X	X		-	-	-
Skipjack herring			X	X									MAR-APR	-	-
Southern flounder	X	X	X	X	X	X	X	X	X	X	X	X	MAR-MAY	-	-
Southern kingfish (whiting)			X	X	X	X	X	X	X	X	X	X	-	-	-
Spot	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-
Spotted seatrout	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-
Striped anchovy				X	X	X	X	X	X	X			MAY-AUG	-	-
Striped bass				X	X	X							APR-JUN	-	-
Striped mullet	X	X	X	X	X	X	X	X	X	X	X	X	NOV-MAY	-	-
White mullet	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-

FRESHWATER RIVERS

NAME	J	F	M	A	M	J	J	A	S	O	N	D	SPAWNING	OUTMIG	LARVAE
Atlantic croaker	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-
Bay anchovy	X	X	X	X	X	X	X	X	X	X	X	X	FEB-OCT	-	-
Blue catfish	X	X	X	X	X			X	X	X	X	X	-	-	-
Bluegill	X	X	X	X	X	X	X	X	X	X	X	X	MAY-SEP	-	-
Channel catfish	X	X	X	X			X	X					MAR-MAR	-	-
Gafftopsail catfish					X	X	X	X	X	X	X		JUN-JUL	-	-
Gulf butterfish	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-
Gulf killifish	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-
Gulf menhaden	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-
Gulf menhaden	X	X								X	X	X	OCT-FEB	-	-
Hardhead catfish				X	X	X	X	X	X	X	X		MAY-AUG	-	-
Harvestfish					X	X	X	X	X	X			-	-	-
Largemouth bass	X	X	X	X	X	X	X	X	X	X	X	X	MAR-MAY	-	-
Longear sunfish		X	X	X	X	X	X	X	X				MAY-JUN	-	-
Pigfish			X	X	X	X	X	X	X	X			-	-	-
Pinfish	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-
Rainwater killifish					X	X	X						-	-	-
Red drum	X	X	X	X	X	X	X	X	X	X	X	X	SEP-OCT	-	-
Redear sunfish	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-
Rough silverside	X	X	X	X	X	X	X	X	X	X	X	X	MAR-SEP	-	-
Sailfin molly	X	X					X	X	X	X	X		-	-	-
Sand seatrout	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-
Scaled sardine				X	X	X	X	X	X	X			-	-	-
Sheepshead	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-
Sheepshead minnow	X	X	X	X	X	X	X	X	X	X	X	X	-	-	APR-OCT
Shiners	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-
Silver perch	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-
Skipjack herring	X		X	X	X	X				X	X		-	-	-
Skipjack herring			X	X									MAR-APR	-	-
Southern flounder	X	X	X	X	X	X	X	X	X	X	X	X	MAR-MAY	-	-
Spot	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-
Spotted seatrout	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-
Spotted sunfish	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-
Striped anchovy					X	X	X	X	X	X	X		MAY-AUG	-	-
Striped bass					X	X	X						APR-JUN	-	-
Striped mullet	X	X	X	X	X	X	X	X	X	X	X	X	NOV-MAY	-	-
White mullet	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-

Shoreline Habitat Descriptions

EXPOSED WALLS AND OTHER SOLID STRUCTURES
MADE OF CONCRETE, WOOD, OR METAL ESI = 1

DESCRIPTION

- These structures are solid man-made structures such as seawalls, groins, revetments, piers, and port facilities.
- Many structures are constructed of concrete, wood, or metal.
- Often there is no exposed beach at low tide, but multiple habitats are indicated if present.
- They are built to protect the shore from erosion by waves, boat wakes, and currents, and thus are exposed to rapid natural removal processes.
- They are heavily utilized by the public for shoreline-based fishing.
- Attached animals and plants are sparse.
- They are not common, comprising about 2 percent of the shoreline.

PREDICTED OIL BEHAVIOR

- Oil is often held offshore by waves reflecting off the steep structures.
- Any oil that is deposited is rapidly removed from exposed faces.
- The most resistant oil would remain as a patchy band at or above the high-tide line.

RESPONSE CONSIDERATIONS

- Cleanup is usually not required.
- Access can be difficult and dangerous.
- High-pressure water spraying may be required to:
  - remove persistent oil;
  - improve aesthetics; or
  - prevent leaching of oil from the structure.

SCARPS AND STEEP SLOPES IN CLAY ESI = 2A

WAVE-CUT CLAY PLATFORMS ESI = 2B

NOT PRESENT IN STUDY AREA

FINE-GRAINED SAND BEACHES ESI = 3A

DESCRIPTION

- These beaches are generally flat and hard-packed; along the Gulf shore they are 50-100 m wide, whereas along bay shores they are ~15 m wide.
- Though they are predominately fine sand, there is often a small amount of shell or shell hash.
- There can be heavy accumulations of wrack present.
- They occur along most of the Gulf coast and island shorelines.
- They undergo gradual erosion / deposition cycles.
- They are heavily utilized by birds for nesting, foraging, and loafing.
- Upper beach fauna include ghost crabs and amphipods; lower beach fauna can be dense, but are highly variable.
- Fine-grained sand beaches are common, comprising 7 percent of the shoreline.

PREDICTED OIL BEHAVIOR

- Light oil accumulations will be deposited as oily swashes or bands along the upper intertidal zone.
- Heavy oil accumulations will cover the entire beach surface; oil will be lifted off the lower beach with the rising tide.
- Maximum penetration of oil into fine-grained sand is about 10 cm.
- Burial of oiled layers by clean sand within the first few weeks after a spill typically will be less than 30 cm along the upper beach face.
- Organisms living in the beach may be killed by smothering or lethal oil concentrations in the interstitial water.
- Biological impacts include temporary declines in infaunal populations, which can also affect important shorebird foraging areas.

RESPONSE CONSIDERATIONS

- These beaches are among the easiest shoreline types to clean.
- Cleanup should concentrate on removing oil and oily debris from the upper swash zone once oil has come ashore.
- Activity through both oiled and dune areas should be severely limited, to prevent contamination of clean areas.
- Manual cleanup, rather than road graders and front-end loaders, is advised to minimize the volume of sand removed from the shore and requiring disposal.
- All efforts should focus on preventing the mixture of oil deeper into the sediments by vehicular and foot traffic.
- Mechanical reworking of lightly oiled sediments from the high-tide zone to the upper intertidal zone can be effective along the Gulf shore.

SCARPS AND STEEP SLOPES IN SAND ESI = 3B

DESCRIPTION

- This shoreline type occurs where sandy bluffs are undercut by waves and slump.
- They normally form along embankments of sandy dredge-spoil material and at cutbanks in rivers.
- Some scarps are fronted by narrow beaches, if the erosion rate is moderate or episodic.
- Biological utilization by infauna and birds is low.
- They are not common in the study area, comprising less than one percent of the shoreline.

PREDICTED OIL BEHAVIOR

- Oil will concentrate at the high water line, with the potential for penetration up to 10 cm into the sandy sediments.
- There is little potential for burial except when a major slumping of the bluff occurs.
- Burial of oiled layers by clean sand within the first few weeks typically will be less than 30 cm along the upper beach face.

RESPONSE CONSIDERATIONS

- Cleanup should concentrate on the removal of oil from the upper swash zone after all oil has come ashore.
- Manual cleanup is advised to minimize the volume of sand removed from the shore and requiring disposal, and reduce the risk of increased slumping and bluff erosion.
- All efforts should focus on preventing the mixture of oil deeper into the sediments.

COARSE-GRAINED SAND BEACHES ESI = 4

NOT PRESENT IN STUDY AREA

MIXED SAND AND GRAVEL (SHELL) BEACHES ESI = 5

DESCRIPTION

- These beaches have sediments composed of a mixture of sand and shell.
- There can be large-scale changes in the sediment distribution patterns along the Gulf shore depending upon season, because of the transport of the sand fraction offshore during storms.
- Because of sediment desiccation and mobility on exposed beaches, densities of animals and plants are lower than sand beaches.
- They are uncommon and comprise less than one percent of the shoreline.

PREDICTED OIL BEHAVIOR

- During small spills, oil will be deposited along and above the high-tide swash.
- Large spills will spread across the entire intertidal area.
- Oil penetration into shelly zones may be up to 50 cm; however, in general oil behavior is much like on a sand beach.
- Burial of oil may be deep at and above the high-tide line, where oil tends to persist.
- Oil can be stranded in the coarse sediments on the lower part of the beach, particularly if the oil is weathered or emulsified.

RESPONSE CONSIDERATIONS

- Heavy accumulations of pooled oil from the upper beachface should be removed quickly to prevent penetration into the porous sediments.
- All oiled debris should be removed.
- Sediment removal should be limited as much as possible.
- Mechanical reworking of lightly oiled sediments from the high-tide zone to the upper intertidal zone can be effective along the Gulf shore.
- In-place tilling may be used to reach deeply buried oil layers in the middle zone on exposed beaches, as an alternative to sediment removal.

GRAVEL (SHELL) BEACHES ESI = 6A

DESCRIPTION

- Gravel beaches in Mississippi are composed almost entirely of shell.
- They can be very steep, with multiple wave-built berms forming the upper beach.
- Shell beaches are common in bays near oyster reefs and along spoil islands where the spoil is reworked by waves into steep shell berms.
- Because of sediment desiccation and mobility on exposed beaches, there are low densities of animals and plants.
- Shell beaches are uncommon, comprising less than one percent of the shoreline.

PREDICTED OIL BEHAVIOR

- Deep penetration of stranded oil is likely on gravel beaches because of their very high permeability.
- On Gulf beaches, oil can be pushed over the high-tide and storm berms, pooling and persisting above the normal zone of wave wash.
- Long-term persistence will be controlled by the depth of penetration versus the depth of routine reworking by waves.
- On the more sheltered bay shoreline, sheening and formation of asphalt pavements is likely where accumulations are heavy.

RESPONSE CONSIDERATIONS

- Heavy accumulations of pooled oil should be removed quickly from the upper beach.
- All oiled debris should be removed.
- Sediment removal should be limited as much as possible.
- Low- to high-pressure flushing can be used to float oil away from the sediments for recovery by skimmers or sorbents.
- Mechanical reworking of oiled sediments from the high-tide zone to the upper intertidal zone can be effective in areas regularly exposed to wave activity (as evidenced by storm berms).
- In-place tilling may be used to reach deeply buried oil layers in the middle intertidal zone on exposed beaches.

EXPOSED RIPRAP STRUCTURES ESI = 6B

DESCRIPTION

- Riprap structures are composed of cobble- to boulder-sized blocks of granite or limestone.
- Riprap structures are placed for shoreline protection and inlet stabilization.
- Attached biota on the riprap can be sparse.
- These structures are highly utilized for shore-based fishing.
- Exposed riprap comprises less than one percent of the shoreline.

PREDICTED OIL BEHAVIOR

- Deep penetration of oil between the boulders is likely.
- Oil adheres readily to the rough rock surfaces.
- If oil is left uncleaned, it may cause chronic leaching until the oil hardens.

RESPONSE CONSIDERATIONS

- When the oil is fresh and liquid, high-pressure spraying and/or water flooding may be effective, making sure to recover all released oil.
- Heavy and weathered oils are more difficult to remove, requiring scrapping and/or hot-water spraying.
- It may be necessary to remove heavily oiled riprap and replace it.

EXPOSED TIDAL FLATS **ESI = 7**

DESCRIPTION

- Exposed tidal flats are broad intertidal areas composed primarily of sand and minor amounts of shell and mud.
- The presence of sand indicates that tidal or wind-driven currents and waves are strong enough to mobilize the sediments.
- They are usually associated with another shoreline type on the landward side of the flat and are most commonly associated with tidal inlet systems.
- Biological utilization can be very high, with large numbers of infauna, heavy use by birds for roosting and foraging, and use by foraging fish.
- They are also highly utilized for recreational fishing.
- Because of the small tidal range, they are uncommon and comprise less than one percent of the shoreline.

PREDICTED OIL BEHAVIOR

- Oil does not usually adhere to the surface of exposed tidal flats, but rather moves across the flat and accumulates at the high-tide line.
- Deposition of oil on the flat may occur on a falling tide if concentrations are heavy.
- Oil does not penetrate water-saturated sediments.
- Biological damage may be severe, primarily to infauna, thereby reducing food sources for birds and other predators.

RESPONSE CONSIDERATIONS

- Currents and waves can be very effective in natural removal of the oil.
- Cleanup is very difficult (and possible only during low tides).
- The use of heavy machinery should be restricted to prevent mixing of oil into the sediments.
- On exposed sand flats, oil will be removed naturally from the flat and deposited on the adjacent beaches where cleanup is more feasible.

SHELTERED SOLID MAN-MADE STRUCTURES **ESI = 8A**

DESCRIPTION

- These structures are solid man-made structures such as seawalls, groins, revetments, piers, and port facilities.
- Many structures are constructed of concrete, wood, or metal.
- Often there is no exposed beach at low tide, but multiple habitats are indicated if present.
- Most of the structures in bays are designed to protect a single lot, thus their composition, design, and condition are highly variable.
- They can have high recreational use, particularly in public areas.
- Attached animal and plant life can be sparse.
- This is the second most common shoreline type, comprising 10 percent of the shoreline.

PREDICTED OIL BEHAVIOR

- Oil will adhere readily to the rough surface, particularly along the high-tide line, forming a distinct oil band.
- The lower intertidal zone usually stays wet (particularly if algae covered), preventing oil from adhering to the surface.

RESPONSE CONSIDERATIONS

- Cleanup is usually conducted for aesthetic reasons or to prevent leaching of oil.
- Low- to high-pressure spraying at ambient water temperatures is most effective when the oil is fresh.

SHELTERED RIPRAP STRUCTURES **ESI = 8B**

DESCRIPTION

- Riprap structures are composed of cobble- to boulder-sized blocks of granite or limestone.
- These structures include revetments, seawalls, piers, and docks constructed of impermeable materials such as concrete.
- They are found inside harbors and bays in highly developed areas, sheltered from direct exposure to waves.
- Sheltered riprap structures comprise less than one percent of the shoreline.

PREDICTED OIL BEHAVIOR

- Deep penetration of oil between the boulders is likely.
- Oil adheres readily to the rough rock surfaces.
- If oil is left uncleaned, it may cause chronic leaching until the oil hardens.

RESPONSE CONSIDERATIONS

- High-pressure spraying may be required to remove oil for aesthetic reasons and to prevent leaching of oil from the structure.
- Cleanup crews should make sure to recover all released oil.

SHELTERED SCARPS ESI = 8C

DESCRIPTION

- Sheltered scarps can be composed of clay formed by dredge-spoil deposits in man-made waterways or steep slopes composed of either clay or sand and covered with terrestrial vegetation.
- There may be some fringing marsh along the water's edge; it is not significant to map.
- They comprise 2 percent of the shoreline.

PREDICTED OIL BEHAVIOR

- Oil will not adhere to the wet sediment surface, but could penetrate burrows if present and dry.
- Stranded oil will persist because of low energy setting.

RESPONSE CONSIDERATIONS

- Where the high-tide area is accessible, it may be feasible to manually remove heavy oil accumulations and oiled debris.
- The muddy substrate cannot support heavy equipment, and even foot traffic could disrupt the sediments and mix oil deeper.

SHELTERED TIDAL FLATS ESI = 9A

NOT PRESENT IN STUDY AREA

RIVERINE BANKS WITH GRASSES OR TREES ESI = 9B

DESCRIPTION

- Either low banks with grasses or low eroding banks with trees and tree roots exposed to the water.
- Flooded occasionally by high water.
- These shorelines are generally found in fresh or brackish water localities.
- This shoreline type is common, comprising over 3 percent of the shoreline.

PREDICTED OIL BEHAVIOR

- During low water stages there is little impact, with the oil coating a narrow band of sediment at the water level.
- During high water, the oil will cover and coat the grasses and base of the trees.
- May cause loss of the grasses, but the trees should survive unless oil penetrates and persists in the substrate.

RESPONSE CONSIDERATIONS

- Low-pressure flushing of oiled areas is effective in removing moderate to heavy accumulations of oil from along the banks.
- Sorbent and containment boom should be placed on the water side of the cleanup operations to contain and collect oil outflow.
- Low- to high-pressure flushing can be used to remove oil from tree roots and trunks, if deemed necessary in high-use areas.

SALT AND BRACKISH WATER MARSHES ESI = 10A

DESCRIPTION

- Marshes are intertidal wetlands containing emergent, herbaceous vegetation.
- Width of the marsh can vary widely, from a narrow fringe to extensive areas.
- They are relatively sheltered from waves and strong tidal currents.
- Sediments are composed of organic muds except on the margins of barrier islands where sand is abundant.
- Resident flora and fauna are abundant with numerous species with high utilization by birds.
- This is the most common shoreline type, comprising 67 percent of the shoreline.

PREDICTED OIL BEHAVIOR

- Oil adheres readily to marsh vegetation.
- The band of coating will vary widely, depending upon the water level at the time oil slicks are in the vegetation. There may be multiple bands.
- Large slicks will persist through multiple tidal cycles and coat the entire stem from the high-tide line to the base.
- If the vegetation is thick, heavy oil coating will be restricted to the outer fringe, although lighter oils can penetrate deeper, to the limit of tidal influence.
- Medium to heavy oils do not readily adhere to or penetrate the fine sediments, but can pool on the surface or in burrows.
- Light oils can penetrate the top few centimeters of sediment and deeply into burrows and cracks (up to one meter).

RESPONSE CONSIDERATIONS

- Under light oiling, the best practice is to let the area recover naturally.
- Heavy accumulations of pooled oil can be removed by vacuum, sorbents, or low-pressure flushing. During flushing, care must be taken to prevent transporting oil to sensitive areas down slope or along shore.
- Cleanup activities should be carefully supervised to avoid vegetation damage.
- Any cleanup activity must not mix the oil deeper into the sediments. Trampling of the roots must be minimized.
- Cutting of oiled vegetation should only be considered when other resources present are at great risk from leaving the oiled vegetation in place.

FRESHWATER MARSHES (HERBACEOUS VEGETATION) ESI = 10B

DESCRIPTION

- Freshwater marshes are grassy wetlands composed of freshwater vegetation.
- They occur upstream of brackish vegetation along major rivers and tributary bayous and creeks.
- Those along major channels are exposed to strong currents and boat wakes; inland areas are highly sheltered.
- The sediment substrate is seldom exposed since daily water level changes are low; greater changes result from floods and wind-generated tides.
- Resident flora and fauna are abundant with numerous species, with high utilization by birds.
- They are not common in the study area, comprising less than one percent of the shoreline.

PREDICTED OIL BEHAVIOR

- Oil adheres readily to marsh vegetation.
- The band of coating will vary widely, depending upon the water level at the time oil slicks are in the vegetation. There may be multiple bands.
- Large slicks will persist through multiple water level changes and coat the entire stem from the high-water line to the base.
- If the vegetation is thick, heavy oil coating will be restricted to the outer fringe, although lighter oils can penetrate to the limit of the marsh.

RESPONSE CONSIDERATIONS

- Under light oiling, the best practice is to let the area recover naturally.
- Heavy accumulations of pooled oil can be removed by vacuum, sorbents, or low-pressure flushing. During flushing, care must be taken to prevent transporting oil to sensitive areas down slope or along shore.
- Cleanup activities should be carefully supervised to avoid vegetation damage.
- Any cleanup activity must not mix the oil deeper into the sediments. Trampling of the roots must be minimized.
- Cutting of oiled vegetation should only be considered when other resources present are at great risk from leaving the oiled vegetation in place.

FRESHWATER SWAMPS (WOODY VEGETATION) ESI = 10C

DESCRIPTION

- Freshwater swamps consist of shrubs and hardwood forested wetlands, essentially flooded forests.
- They are common along major river valleys, such as the Pearl, Escatawpa, and Pasacgoula.
- The sediment tend to be silty clay with large amounts of organic debris.
- They are seasonally flooded, though there are many low, permanently flooded areas.
- Resident flora and fauna are abundant with numerous species.
- Swamps are common, comprising 7 percent of the shoreline.

PREDICTED OIL BEHAVIOR

- Oil behavior depends on whether the swamp is flooded or not.
- During floods, most of the oil passes through the forest, coating the vegetation above the water line, which changes levels throughout the flood event.
- Oiled woody vegetation is less sensitive than marshes to oil coating.
- Some oil can be trapped and pooled on the swamp flood plain as water levels drop.
- Penetration into the floodplain soils is usually limited because of high water levels, muddy composition, surface organic debris, and vegetation cover.
- Large amounts of oily debris can remain.
- During dry periods, terrestrial spills flow downhill and accumulate in depressions or reach water bodies.

RESPONSE CONSIDERATIONS

- Under light oiling, the best practice is to let the area recover naturally.
- Heavy accumulations of pooled oil can be removed by vacuum, manual removal, or low-pressure flushing. During flushing, care must be taken to prevent transporting oil to sensitive areas down slope or along shore.
- Under stagnant water conditions, herding of oil with water spray may be needed to push oil to collection areas.
- Oily debris can be removed where there is access.
- Any cleanup activity must not mix the oil deeper into the sediments. Trampling of the roots must be minimized.
- Cutting of oiled vegetation should only be considered when other resources present are at great risk from leaving the oiled vegetation in place.